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Superhyperfine structure of EPR spectra in LiLuF 4:U 3+ and LiYF 4:Yb 3+ single crystals

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Abstract

Electron paramagnetic resonance (EPR) spectra of doped paramagnetic crystals LiLuF 4:U 3+ and LiYF 4:Yb 3+ have been investigated at a frequency of about 9.42 GHz in the temperature range of 10-20 K. The U 3+ ion spectrum is characterized by g-factors g ∥ = 1.228 and g ⊥ = 2.516, and contains the hyperfine structure due to the 235U isotope with nuclear spin I = 7/2 and natural abundance of 0.71%. The observed hyperfine interaction constants are A ∥ = 81 G and A ⊥ = 83.8 G. Moreover, the spectrum reveals the well-resolved superhyperfine structure (SHFS) due to two groups of four fluorine ions forming the nearest surrounding of the U 3+ ion. This SHFS contains up to nine components with the spacing between components being about 12.7 G. The SHFS is observed also in the EPR spectrum of the LiYF 4:Yb 3+ crystal; up to 17 components with spacing of about 3.7 G may be traced. Some parameters of the effective Hamiltonian of the SHF interaction are estimated, the contribution of covalent bonding of f-electrons with ligands into these parameters is discussed.

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